What is the Huxley crossbridge model and the Hill model of muscle?
Which parameters do they describe?

Lab due Friday
Extra credit coming
Office hours (Friday @ 11, after
Spring Break: Tues @ 12:30 
Presentations start
April 12 ~ 1 month
A single motor unit has one axon that innervates multiple muscle fibers (10-600 fibers depending on which muscle)

twitch = basic motor unit firing
Show muscle twitch and tetanus papers

Physiological model of crossbridge cycle between myofilaments (actin & myosin)

Where does Calcium ($\text{Ca}^{2+}$) come from?

crossbridge video
A. F. Huxley’s 1957 Crossbridge Model for isotonic shortening

See McMahon Chap 4 reading

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**Muscle race for funding...**

Hugh Huxley → 1953 (MIT)

1. Let’s think mechanically
   - As the actin-f myosin connects
   - Force generated at the cross-bridge site
The way to generate force at the cross-bridge is if the spring is already extended when the cross-bridge attaches.
Huxley model

1. Crossbridge attachment distributions
   Rate based on:
   \( n(x) = \text{probability that crossbridge at } x \text{ is attached} \)
   \( (0 - 1) \)
   \( f(x) = \text{rate constant for attachment} \)
   \( g(x) = \text{rate constant for detachment} \)

\[
\frac{dn(x)}{dt} = \left[ 1 - n(x) \right] f(x) - n(x) g(x)
\]
Huxley’s crossbridge model

- Final expressions for crossbridge attachment distributions in each region:

\[ n < 0: \quad n = \frac{f_i}{f_i + g_i} \left[ 1 - e^{-\phi/V} \right] e^{2g_i x/sV} \],

\[ 0 \leq x \leq h: \quad n = \frac{f_i}{f_i + g_i} \left[ 1 - e^{\left(\frac{x}{h}\right)\phi/V} \right] \],

\[ x > h: \quad n = 0. \]

\[ \phi = (f_i + g_i)^* \left( \frac{h}{s} \right), \quad \phi \text{ is just a convenient constant} \]
\[ s = \text{length of one sarcomere} \]
\[ V = \text{normalized rate of shortening in half-sarcomere lengths per second (i.e., normalized shortening velocity)}. \]
If we plot \( n \) vs. \( x/h \) for different \( V \), we can gain insight into the distribution of crossbridges, displacement, and shortening velocity.

Huxley’s crossbridge model

(2) Relationship between distribution of attached crossbridges, displacement, and shortening velocity

- Result: plots of \( n \) vs. \( x/h \) based on \( V \).
Exam